

3.17 ESSENTIAL FISH HABITAT – AFFECTED ENVIRONMENT

3.17.1 Introduction

This assessment and other components of this document represent the initiation of Essential Fish Habitat (EFH) consultation with the National Marine Fisheries Service in compliance with the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1801-1882), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267). The impact analyses of the EFH assessment are presented in Section 4.18.

3.17.1.1 Description of the Proposed Action

The Proposed Action consists of the redevelopment and construction of a large-scale casino destination resort at the existing Broadwater Resort and President Casino in Biloxi, Harrison County, Mississippi (Baker, 1998a). The Proposed Action encompasses a total of 325 acres of existing or newly created lands for development and can be divided into two distinct areas north and south of US 90. South of US 90 the applicant proposes to develop six dockside casinos, eight hotels, a transportation center, an entertainment complex, retail facilities, a new marina, and related parking. North of US 90 the applicant proposes to develop four hotels and a retail complex, a water and amusement park, a Cineplex Theater and related parking, and improvements to the Sun Golf Course. Chapter 2.0 provides detailed descriptions of the Proposed Action and its alternatives.

3.17.1.2 Description of the Approach to Protection of EFH

The Magnuson-Stevens Fishery Conservation and Management Act of 1976, as amended through 1998, establishes a new requirement to describe and identify “essential fish habitat” (EFH) in each fishery management plan. This act sets forth a new mandate for the National Marine Fisheries Service (NMFS), regional fishery management councils (FMC), and other federal agencies to identify and protect important marine and anadromous fish habitat. The EFH provisions of the act support maintenance of sustainable fisheries, which is one of the overall management goals for the nation’s marine resources.

EFH is defined as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.” *Waters* include aquatic areas and their associated physical, chemical, and biological properties. *Substrate* includes sediment underlying the waters. *Necessary* means the habitat required to support a sustainable fishery and the managed species’ contribution to a healthy ecosystem. *Spawning, breeding, feeding, or growth to maturity* covers all habitat types used by a species throughout its life cycle. Only species managed under a federal fishery management plan (FMP) are covered (50 C.F.R. 600). The act requires federal agencies to consult on activities that may adversely affect EFH designated in the FMPs. The activities may have direct (e.g., physical disruption) or indirect (e.g., loss of prey species) effects on EFH and may be site-specific or habitat-wide. The adverse effect must be evaluated individually and cumulatively.

3.17.2 *Affected Environment*

3.17.2.1 *Description of EFH Habitats Present in the Study Area*

Wetlands

Study area wetlands identified as EFH in the generic amendment to the Fishery Management Plans for the Gulf of Mexico include intertidal wetlands (i.e., salt marsh) (GMFMC, 1998). As described in Section 3.4, the majority of the Biloxi peninsula has been heavily developed to the extent that natural vegetative communities are extremely limited in this area. Most of the peninsula shoreline has been bulkheaded or is contained with riprap. One small area of disturbed intertidal wetland occurs along the northeast portion of the peninsula. A small amount of salt marsh exists along portions of Back Bay, and more substantial areas of intertidal wetlands occur towards the western portion of the peninsula as Back Bay meets the Biloxi River. Biloxi Bay contains extensive areas of salt marsh within the upper fringes of the bay and along the shorelines of several islands in the bay. The Mississippi Sound also contains extensive areas of salt marsh along the leeward side of the barrier islands. Additional information regarding wetlands of the Broadwater site is contained in Section 3.4.

Submerged Aquatic Habitat

The Mississippi Sound contains a number of different submerged aquatic communities, including seagrass beds, marine algae, mollusk reef, and unconsolidated bottom communities. The generic amendment to the Fishery Management Plans for the Gulf of Mexico identifies all of these habitats and the water column as EFH (GMFMC, 1998).

As discussed in Section 3.4, seagrass beds are found predominately along the north side of the barrier islands but have occurred in smaller beds near the beach (MDMR, 1998). In a study by Moncrieff et al. (1998), seagrass distributions and potential habitat were determined for Mississippi Sound along the northern shorelines of Ship, Horn, and Petit Bois Islands that had historically supported populations of the four seagrasses. These areas appeared to only support beds of shoal grass during the time of the study. Eleuterius (1973) found well-developed grass beds at Round and Cat Islands in the past. Moncrieff et al. (1998) found only populations of shoal grass west and north of Cat Island and no seagrasses in the waters surrounding Round Island. No seagrass beds are known to occur within the study area. Seagrass beds are extremely productive ecosystems and their complexity in both structure and function is due to the great diversity and abundance of organisms present (Sullivan et al., 1991; Daehnick et al., 1992; Moncreiff et al., 1992). Seagrass beds provide important nursery habitat for larval and juvenile stages of fish and invertebrates, many of which are economically important (Randall et al., 1998). Additional information regarding seagrasses and their status in the Mississippi Sound is contained in Section 3.4.

The majority of nearshore and subtidal habitats within the study area and general vicinity consist of unconsolidated bottom (referred to in the context of this document as unvegetated shallow water bottom). As defined by the Shallow Water Committee, shallow water refers to "...all

1 marine and estuarine waters within 4 meters below Mean Low Water (MLW) including the
2 intertidal zone." This definition was developed to cover the zone of maximum interaction
3 between human activities and critical biological resources. An important component of the
4 shallow water region consists of unvegetated shallow water habitats, such as mudflats, sandflats,
5 and shallow subtidal areas. These "bare" habitats represent some of the most productive
6 ecosystems, even though they lack a vegetated component (i.e., SAV beds) (Reilly et al., 1999).
7 The primary productivity of sandflats and mudflats is often underestimated. Benthic microalgae
8 located in these habitats are recognized as significant primary producers within these shallow
9 aquatic ecosystems (Mallin et al., 1992; MacIntyre et al., 1996). The taxonomic composition and
10 biomass of the benthic microalgae community present can be affected by sediment sorting,
11 compaction, organic content, porewater content, nutrient availability, redox gradient, and
12 numerous other variables (Cahoon et al., 1999). Benthic microalgae production and biomass can
13 equal or surpass that of the phytoplankton in the overlying water column (Varela and Penas,
14 1985; Lukateliich and McComb, 1986). Rakocinski et al. (1999) in a study on blue crab
15 recruitment dynamics focused on these soft-sediment areas because they form the largest share of
16 potential habitat for benthic recruitment in the Mississippi Sound. Additional information
17 regarding the composition and distribution of soft bottom substrates in the study area is provided
18 in Section 3.4.

19
20 Solid substrate located in the vicinity of the study area is generally limited to oyster reefs,
21 scattered shell, other organic detritus, and material introduced by man (Christmas, 1973). Oyster
22 reefs and man-made materials (i.e. riprap, pilings, etc.) provide habitat and shelter for numerous
23 macroinvertebrates and fishes, in addition to providing additional substrate for attachment
24 (Wells, 1961; Wieland, 1994).

25
26 Habitats of the Mississippi Sound that constitute EFH cover large areas and extend through much
27 of coastal Alabama, Louisiana, and Texas for some of the managed species. The shallow
28 estuarine habitats of the study area were designated as EFH based primarily on an analysis of
29 Level 1 and Level 2 data. The Final Rule for implementation of the EFH amendments calls for
30 the analysis of existing information at four levels of detail to identify and describe EFH. Level 1
31 involves the analysis of presence/absence distributional data. Levels 2 through 4 involve an
32 analysis of habitat-related density; growth, reproduction, and survival by habitat; and production
33 rates by habitat, respectively. The GMFMC also has designated Habitat Areas of Particular
34 Concern (HPACs). HPACs are comprised of EFH subsets that are "rare, particularly susceptible
35 to human-induced degradation, especially ecologically important, or located in an
36 environmentally stressed area" (GMFMC, 1998). The only specific area designated as an HPAC
37 in Mississippi Sound is Grand Bay; however, area-wide HPACs that occur in Mississippi Sound
38 include hard bottoms and SAV (GMFMC, 1998). No HPACs are present within any of the sites
39 of the Proposed Action or its alternatives.
40

3.17.2.2 Living Marine Resources

This section, in addition to Section 3.4, addresses the Living Marine Resources (LMRs) that exist within the Mississippi Sound and Back Bay region. Section 3.4 provides information on the LMRs of aquatic plants, invertebrates, and fish relative to the study area. This section concentrates on the managed species, associated species, aquatic resources of national importance, and other additional species of concern.

Managed Species

The species addressed in this section consist of commercially important fish and invertebrates that are managed under the Magnuson-Stevens Fishery Conservation and Management Act (PL 94-265). Managed species identified by the Gulf of Mexico Fishery Management Council that are known to occur in the Mississippi Sound and Back Bay area are identified in Table 3.17-1.

Table 3.17-1
Species Considered in the Evaluation of Impacts to EFH

Common Name	Species Name
Red drum	<i>Sciaenops ocellatus</i>
Gray snapper	<i>Lutjanus griseus</i>
Spanish mackerel	<i>Scomberomorus maculatus</i>
Brown shrimp	<i>Penaeus aztecus</i>
Pink shrimp	<i>Penaeus duorarum</i>
White shrimp	<i>Penaeus setiferus</i>
Gulf stone crab	<i>Menippe adina</i>
Stone crab	<i>Menippe mercenaria</i>
Spiny lobster	<i>Panulirus argus</i>

Source: staff analysis.

These species are described in the following accounts, which include a summary of survey results for the Biloxi Bay subarea from the Cooperative Gulf of Mexico Estuarine Inventory (GMEI) Study, Mississippi. The GMEI study divided the sampling area into subareas and zones. Zones 1 through 5 (Figure 3.17-1) indicate approximate bottom salinity distribution similarities observed during the study. The study area is generally associated with Zones 3 and 4 of the Biloxi Bay subarea, with Zones 1 and 2 located further inland and Zone 5 located further out into the Gulf of Mexico (Christmas, 1973). In addition, the presence or absence of each species at Gulf Coast Research Laboratory (GCRL) trawl survey sampling locations in the general vicinity of the study area is also indicated (GCRL, 1987-1997). See Figure 3.17-1 for locations of sampling stations for GMEI Biloxi Bay subarea and GCRL trawl surveys relative to the study area.

The catch per unit effort values given from the GMEI study indicate the number of fish caught by an amount of effort. Typically, effort is a combination of gear type, gear size, and length of time gear is used. The gear type used during the GMEI consisted of trawl and seine. Catch per unit of effort (CPUE) is often used as a measurement of relative abundance for an individual species

1 with higher CPUE values indicating greater relative abundance. Each species account includes
2 the overall CPUE for all zones (Zones 1 through 5) within the Biloxi Bay subarea. These values
3 provide general insight into the relative abundance of species within the entire Biloxi Bay
4 subarea. Additional qualitative and quantitative summary information specific to Zones 3 and 4
5 of the Biloxi Bay subarea is also provided where available.

6 *Red drum*

7
8 Red drum occur in the Gulf of Mexico from extreme southwest Florida continuously along the
9 Gulf coast into northern Mexico (GMFMC and GSMFC, 1984). In the Mississippi Sound, the
10 greatest numbers of adults occur during the spring and fall. Red drum can be found in salinities
11 from 0 to 40 ppt, with optimal salinities of 30 to 35 ppt. Adult forms prefer habitats of muddy,
12 sandy, or oyster reef substrates where they feed on crustaceans and fish. Mature adults school
13 and return to open Gulf waters in late fall and winter. Spawning occurs from late August to
14 January, peaking in late September through October in schools near and in barrier island passes.
15 Larvae enter estuarine waters (8 to 27 ppt) from September through November where they prefer
16 quiet shallow waters over seagrass beds or muddy substrates. Postlarval forms migrate further
17 into inshore estuarine areas, where they remain for two years, and feed primarily on copepods
18 and copepod nauplii. Juveniles reside in protected areas near fringes of marshlands and feed on
19 mysid shrimp, other invertebrates, and small fish. During periods of cold weather, juveniles
20 migrate to nearshore Gulf waters and back to estuarine waters in early spring (MDMR, 1998).
21 Subadults are distributed throughout inshore bays and bayous where they remain until maturity
22 (GMFMC and GSMFC, 1984).

23
24 A total of only ten red drum were collected by the GMEI study, all in Zone 4; however, these
25 were collected outside the Biloxi Bay subarea. No red drum were collected within Zones 3 and 4
26 of the Biloxi Bay subarea. The Biloxi Bay subarea had an overall CPUE of 0.02 (Christmas,
27 1973). Based on the GMEI, red drum are uncommon in the study area. However, trawl surveys
28 conducted by the GCRL have documented the occurrence of red drum in the general vicinity of
29 the study area (Figure 3.17-1) (GCRL, 1987-1997).

30 31 *Gray snapper*

32
33 Gray snapper occur on both sides of the Atlantic, as well as in the Gulf of Mexico. It occurs in a
34 wide variety of habitats and environmental conditions within its range. Habitats include offshore
35 reefs to depths of 246 feet, inshore areas, mangroves in tidal creeks and lagoons, estuaries, and
36 seagrass beds of *Thalassia*, *Ruppia*, *Halophila*, and *Diaplanthera*. This species also occurs
37 within a wide range of salinities from 0 to 35 ppt. The gray snapper moves into fresh water
38 during the spring and migrates to deeper offshore waters during the colder months (Benson,
39 1982). Females predominate at inshore sites; while males are more frequent at offshore sites.
40 Spawning occurs offshore from June to August (GMFMC, 1981a). Juveniles occupy shallow
41 water areas of estuarine bays where they feed primarily on small crustaceans and larval fish.
42 Estuarine habitats include vegetated shorelines, mud bottoms, and sandy grass beds (Benson,
43 1982). Adults at inshore areas feed primarily on crustaceans, particularly portunid crabs, and
44 benthic fish. At offshore locations, adults feed primarily on fish with crustaceans being
45 secondary (GMFMC, 1981a).

1 The gray snapper is considered uncommon in the Mississippi Sound area and was not collected
2 during regular sampling events associated with the GMEI study. However, other sources have
3 reported its occurrence in the Mississippi Sound area (Christmas, 1973). Trawl surveys
4 conducted by the GCRL have documented the occurrence of gray snapper in the general vicinity
5 of the study area (Figure 3.17-1) (GCRL, 1987-1997).

6 7 *Spanish mackerel*

8
9 In the Gulf of Mexico, Spanish mackerel are most abundant along the western coast of Florida.
10 Adults migrate from the Florida coast to Mississippi waters to spawn in the spring and summer
11 and return in the fall (Benson, 1982). Within the study area, juvenile stages are more dependent
12 on the estuarine waters of the Mississippi Sound than the adult form. Large schools of juveniles
13 are occasionally seen in the sound and adjacent bays during the spring and summer months in
14 salinities ranging from 5 to 30 ppt. Juveniles prefer areas of clean sand bottoms. Adults prefer
15 salinities greater than 20 ppt and occur in large, dense schools near the barrier islands and
16 offshore Gulf waters. Small fish comprise the primary food source of Spanish mackerel.
17 Spawning is nocturnal in offshore water ranging in salinities from 28 to 38 ppt from May to
18 September. Larvae are most abundant over shallow continental shelf waters at depths of 39 to
19 111 feet (MDMR, 1998).

20
21 A total of nine juvenile Spanish mackerel were collected during the GMEI, all outside of Zones 3
22 and 4 of the study area. The Biloxi Bay subarea had an overall CPUE of 0.01. The only other
23 subarea to have Spanish mackerel present was Bay St. Louis at a CPUE of 0.01 (Christmas,
24 1973). Based on the GMEI, Spanish mackerel are uncommon in the study area. Trawl surveys
25 conducted by the GCRL documented the occurrence of Spanish mackerel in the general vicinity
26 of the study area (Figure 3.17-1) (GCRL, 1987-1997).

27 28 *Brown shrimp*

29
30 The postlarval, juvenile, and subadult stages of the brown shrimp rely more on the estuarine
31 waters of the Mississippi Sound and bays than the adult form. Postlarvae migrate from offshore
32 Gulf waters to estuarine nursery grounds from January through November with peak migration
33 from February through May. Postlarval forms prefer soft mud substrates within shallow
34 estuarine environments at salinities above 10 ppt where they feed on detritus and scavenge
35 among bottom sediments. As growth continues, juveniles seek mixed mud and sand bottoms as
36 well as vegetated areas. Juvenile feeding is concentrated at the marsh-open water interface and
37 in submerged grass beds, which provide both a source of detritus and cover (GMFMC, 1981). At
38 this stage, juveniles have omnivorous feeding habits with fecal pellets being an important food
39 source. Subadults occur throughout the Mississippi Sound during the spring, summer, and early
40 fall months; at this time massive migrations occur to and through island passes and into Gulf
41 waters. Adults reach maturity in offshore Gulf waters within the first year of life (MDMR,
42 1998).

43
44 Brown shrimp comprised the second most abundant commercial invertebrate collected during the
45 GMEI study. Although the largest catch occurred in Zone 3, the brown shrimp was caught in all

1 zones. The Biloxi Bay subarea had an overall CPUE of 26.46, with catches generally
2 concentrated from May through August. Zones 3 and 4 of the Biloxi Bay subarea had CPUEs of
3 122.34 and 17.07, respectively (Christmas, 1973). Based on the GMEI, brown shrimp are
4 common throughout the study area with higher relative abundances in the Back Bay area. Trawl
5 surveys conducted by the GCRL have also documented the occurrence of brown shrimp in the
6 general vicinity of the study area (Figure 3.17-1) (GCRL, 1987-1997).

7 8 *Pink shrimp*

9
10 Pink shrimp prefer firm mud or silt bottoms with calcareous sediments and are most common
11 along the Florida coast (GMFMC, 1981). Postlarval, juvenile, and subadult stages rely more on
12 the estuarine waters of the Mississippi Sound and bays than the adult form. Postlarvae are found
13 in the sound from July through December with occurrence generally peaking from August
14 through September, depending on the salinities. Postlarval forms prefer moderate to high
15 salinities (20 ppt and higher) and feed primarily at night, scavenging on the bottom and feeding
16 on suspended detritus. Juveniles are most abundant in seagrasses around the offshore barrier
17 islands. Juveniles have omnivorous feeding habits with fecal pellets being an important food
18 source. Subadults are found in inshore waters and near barrier islands during the fall, winter, and
19 spring. Adults generally reach maturity in offshore waters during the first year. Peak spawning
20 is believed to occur offshore from early summer through fall and may be continuous in deeper
21 waters throughout the year (MDMR, 1998).

22
23 Pink shrimp were by far the least abundant of the three commercial shrimp species collected
24 during the GMEI study. Catches were concentrated from August through November, and the
25 largest catch occurred in Zone 4 of the Pascagoula River estuary. The Biloxi Bay subarea had an
26 overall CPUE of 0.87, with no pink shrimp collected in Zones 3 and 4 of the study area
27 (Christmas, 1973). Based on the GMEI, pink shrimp are uncommon in the study area. However,
28 trawl surveys conducted by the GCRL have documented the occurrence of pink shrimp in the
29 general vicinity of the study area (Figure 3.17-1) (GCRL, 1987-1997).

30 31 *White shrimp*

32
33 Postlarval, juvenile, and subadult stages are more dependent on the estuarine waters of the
34 Mississippi Sound and bays than the adults. Postlarvae migrate into local estuarine waters from
35 June through September and prefer salinities of 10 ppt or less. They feed on detritus and
36 scavenge on bottom sediments. Juveniles peak in numbers within one to two months after peak
37 postlarvae immigrations in shallow marsh areas. Juveniles have omnivorous feeding habits with
38 fecal pellets being an important food source. Subadults migrate during the summer and fall from
39 estuarine environments to island passes and open Gulf waters. Some subadults may migrate
40 during late fall and overwinter in shallow Gulf waters and re-enter the estuarine environment
41 during April and May, at which time they reach maturity and again migrate to Gulf waters to
42 spawn. Adults generally reach maturity in offshore waters during the first year. Spawning
43 occurs during the warmer months (April through August) in Gulf waters (MDMR, 1998).

White shrimp were the most abundant commercial invertebrate collected in trawls and seines during the GMEI study. White shrimp were collected in great abundance in Zones 2 and 3 of the Biloxi Bay subarea with CPUEs of 182.45 and 216.32, respectively. Zone 4 had a CPUE of 1.23. Zones 3 and 4 of the Biloxi Bay subarea are within the study area. The Biloxi Bay subarea had an overall CPUE of 61.41, with catches generally concentrated from July through November (Christmas, 1973). Based on the GMEI, white shrimp are common in the study area with higher relative abundances in the Back Bay area. Trawl surveys conducted by the GCRL have also documented the occurrence of white shrimp in the general vicinity of the study area (Figure 3.17-1) (GCRL, 1987-1997).

Gulf stone crab

The gulf stone crab is a newly recognized species found from northwest Florida to Tamaulipas State, Mexico. In the Mississippi Sound, it is found primarily over mud bottoms near the barrier islands and near channels and bottom obstructions. Adults appear in greatest numbers from March through June in the southern region of the Mississippi Sound and exhibit large interannual fluctuations in abundance. Sponge crabs can be found from April through September in the mid to lower regions of the sound. Larvae occur in the lower portions of the Mississippi Sound and adjacent offshore waters. All larval stages have been found occurring together, indicating that development is completed entirely within local waters. Juveniles are common on hard bottoms, such as oyster reefs, and on bottom obstructions over mud bottoms. Peak abundance of small juveniles occurs from July through October. All stages of the gulf stone crab are found in salinities above 15 ppt. Both juveniles and adults feed on mollusks, polychaete worms, and crustaceans (MDMR, 1998).

Due to the recent recognition of the gulf stone crab as an accepted species, the GMEI study does not provide any relevant data regarding its presence or absence in the Mississippi Sound area; however, GCRL has documented its occurrence in the general vicinity of the study area (Figure 3.17-1) (GCRL, 1987-1997). In a study by Stuck and Perry (1992), juveniles were collected in every month of the study from a variety of habitats, including mud, sand, oyster reefs, and "shell-hash" bottoms. Adult gulf stone crabs were collected throughout the Mississippi Sound during all seasons; however, relative abundance was much higher during September through October and in the vicinity of barrier island passes. The gulf stone crab was found to be able to complete its entire life cycle within Mississippi coastal waters due to presence of crabs in the five zoeal, megalopal, juvenile, and adult life stages in samples collected throughout the study (Stuck and Perry, 1992).

Stone crab

Stone crabs are found from the Yucatan peninsula through the Gulf of Mexico into the Atlantic Ocean as far north as Cape Lookout, North Carolina. Females move to grass beds and produce six to ten egg masses during each spring-summer spawning season. The planktonic larvae remain in the water column from 20 to 35 days and prefer warm stable seawater salinities. Juveniles migrate from offshore waters to coastal estuaries. Juveniles show a preference for estuaries with extensive oyster bars (GMFMC, 1979). The GMEI study observed stone crabs

1 living around crevices of the seawall of the Pascagoula River estuary (Christmas, 1973). Similar
2 habitat occurs within the study area. Adults can be found in both shallow waters and offshore
3 waters to depths of 177 feet (Christmas, 1973; GMFMC, 1979). Both juveniles and adults feed
4 on mollusks, polychaete worms, and crustaceans (MDMR, 1998).

5 A total of nine stone crabs were collected by trawl and seine during the GMEI study. The
6 individuals collected were found along the seawall in Zone 4 of the Pascagoula River estuary.
7 No individuals were collected in Zones 3 and 4 of the Biloxi Bay subarea (Christmas, 1973).
8 Based on the GMEI, the occurrence of stone crab would be very uncommon. No occurrences
9 were documented by GCRL (1987-1997).

11 *Spiny lobster*

13 The spiny lobster occurs along the east coast of the Americas from North Carolina to Rio de
14 Janeiro, Brazil. The U.S. fishery for this species is primarily restricted to south Florida where
15 abundance is greatest due to more favorable habitat conditions. During its life cycle, the spiny
16 lobster occupies three major habitats. Larvae occur in the open ocean in the epipelagic zone of
17 the Caribbean Sea, Gulf of Mexico, and Straits of Florida. Postlarvae and juveniles occupy
18 shallow coastal waters of bays, lagoons, and reef flats. These habitats are supported by the
19 production of seagrasses, benthic algae, phytoplankton, and detritus. Within these habitats,
20 postlarvae and juveniles depend on rocks, root structures, pilings, and natural holes and crevices
21 to find refuge. As their size increases, spiny lobsters move toward deeper water in reef and
22 rubble areas. Hard structures provide shelter during the day. At night, the spiny lobster forages
23 among seagrasses and rubble areas for mollusks and other food (GMFMC, 1981b).

25 The GMEI study made no note of finding adult forms of the spiny lobster during their surveys.
26 Zooplankton samples taken during this study were inconclusive for spiny lobster due to a number
27 of unidentified zoeae (Christmas, 1973). Based on the GMEI, the occurrence of spiny lobster
28 would be very uncommon. No occurrences were documented by GCRL (1987-1997).

30 Associated Species

32 Associated species consist of living marine resources that occur in conjunction with the species
33 discussed in this section. For example, associated species include the primary prey species of
34 predatory fish species. Typical prey of the three predatory managed fish species (red drum, gray
35 snapper, and Spanish mackerel) include small fish, shrimp, crabs (*Callinectes* spp.), and other
36 invertebrates. Small fish preyed upon by these species include anchovies (*Anchoa* spp.), Atlantic
37 threadfin herring (*Opisthonema oglinum*), tidewater silversides (*Menidia peninsulae*), menhaden
38 (*Brevoortia* spp.), and mullet (*Mugil* spp.) (Benson, 1982). These associated species occupy a
39 wide range of habitats within the Mississippi Sound waters. All of these taxa, along with the
40 three species of shrimp described above and numerous crab species, are known from the general
41 vicinity of the study area (GCRL, 1987-1997). Information on additional associated species in
42 the study area can be found under Aquatic Resources of Section 3.4.

Aquatic Resources of National Importance

In accordance with Part IV, Section 3(a) of the current Memorandum of Agreement between the Departments of Commerce and Army regarding Section 404(q) of the Clean Water Act, the NMFS has identified aquatic resources of national importance (ARNI) for the study area. As identified in Section 906(e)(1) of the Water Resources Development Act of 1986, penaid shrimp (*Penaeus* spp.), blue crab, gray snapper, red snapper (*Lutjanus campechanus*), Spanish mackerel, red drum, Gulf menhaden, bluefish (*Pomatomus saltatrix*), spotted seatrout, Atlantic croaker, mullet, and flounder (*Paralichthys* spp.) are ARNI (letter from A. Mager, Jr., Assistant Regional Administrator, Habitat Conservation Division, NMFS, St. Petersburg, FL to Col. J. Norwood, District Engineer, USACE, Mobile, AL, October 29, 1998). The sand and mud bottoms of the Mississippi Sound and Back Bay are used by these species to meet feeding, growth, and survival needs during their life cycles.

The penaid shrimp, Spanish mackerel, gray snapper, and red drum are also managed species and are described in the previous section. The following descriptions address the remainder of the ARNI species and include a summary of survey results for the Biloxi Bay subarea from the GMEI study (Christmas, 1973). In addition, the presence or absence of each species at GCRL trawl survey sampling locations in the general vicinity of the study area is also indicated (GCRL, 1987-1997).

Blue crab

Adults mate throughout the Mississippi Sound and in nearshore low salinity estuarine waters from March through November. Females move to higher salinity waters near the barrier islands when eggs are near hatching. A general movement of adults occurs from offshore to nearshore island waters with warmer temperatures in the spring. Adults are omnivorous, with mollusks being their dominant food source. Larval zoeae (young stages of crustaceans) occur in offshore Mississippi waters from spring through fall in salinities rarely below 21 ppt. Zoeae develop offshore and can be carried considerable distances via currents. At this stage, blue crab zoeae are filter feeders. Megalopae (advanced larval stage of a crab) enter coastal waters and occur throughout the year with peak abundances in late summer and early fall. Peak megalopal settlement varies from year-to-year. Once the blue crab has reached the megalops stage, it is omnivorous and its diet includes fish, shellfish larvae, and aquatic plants (MDMR, 1998; Perry et al., 1998). In a study by Morgan et al. (1996), megalopae strongly preferred to settle on vegetation.

Blue crabs collected during the GMEI were most abundant in Zone 4 of the Biloxi Bay subarea. The Biloxi Bay subarea had an overall CPUE of 3.86, with catches generally concentrated from April through June. Zones 3 and 4 of the Biloxi Bay subarea had CPUEs of 4.78 and 13.53, respectively (Christmas, 1973). Based on the GMEI, blue crab are common throughout the study area with higher relative abundances in the area just east of Deer Island. Trawl surveys conducted by the GCRL have also documented the occurrence of blue crabs in the general vicinity of the study area (Figure 3.17-1) (GCRL, 1987-1997). Rakocinski et al. (1999) studied recruitment dynamics of early blue crab stages on soft-sediment within the Mississippi Sound.

1 From 156 suction samples representing 13 collections, a total of 1,399 individuals (comprised of
2 both *Callinectes sapidus* and *C. similus*) ranging in carapace width between two and 28 mm were
3 obtained. Peak settlement episodes observed by the use of collectors in surface waters of Gulf
4 cost estuaries, including the Mississippi Sound, showed values that were two to three orders of
5 magnitude greater than those observed for the East coast (Rabalais, 1995).

6 7 *Red snapper*

8
9 The red snapper occurs northward to Massachusetts and southward to Brazil. It is also found in
10 the Gulf of Mexico, where it is perhaps the most abundant. The species prefers deeper offshore
11 reefs or hard bottom areas as an adult. In the northern Gulf of Mexico, the red snapper is often
12 found associated with coral reefs or limestone outcroppings. Adults are generally found in
13 deeper areas in the winter (98 to 213 feet), and during the warmer months there is evidence that
14 the species moves from offshore reefs to inshore reefs (65 to 98 feet). An offshore migration
15 appears to occur during warmer months, presumably for spawning purposes. During this time,
16 individuals have been captured over open sand or on softer substrates. Juveniles are most often
17 collected inshore in sandy or mud bottom shallow areas (32 to 115 feet) in the shrimp ground
18 area east, west, and south of the Mississippi Delta. This area is considered a nursery area since
19 large numbers of specimens have been taken as incidental catch by shrimpers and industrial fish
20 trawlers (GMFMC, 1981a). The red snapper is considered carnivorous, feeding primarily on
21 squid and fish. The species is generally considered a bottom feeder; however, the presence of
22 squid and gastropod larvae in the stomachs indicates a tendency for the species to feed off the
23 bottom in the water column. Juveniles often have shrimp found in their guts (GMFMC, 1981a).

24
25 Red snapper were not collected during regular sampling events associated with the GMEI study.
26 However, a concurrent offshore project did document their occurrence in the Mississippi Sound
27 area (Christmas, 1973). Trawl surveys conducted by the GCRL have documented the occurrence
28 of red snapper in the general vicinity of the study area (Figure 3.17-1) (GCRL, 1987-1997).

29 30 *Gulf menhaden*

31
32 Gulf menhaden are found in the Mississippi Sound and surrounding waters and can tolerate a
33 wide range of temperatures and salinities. During the spring and summer, adults congregate near
34 the mainland shoreline in lower salinity waters (5 to 15 ppt). Adults move offshore to warmer,
35 higher salinity (greater than or equal to 30 ppt) waters in the fall and winter. Spawning occurs
36 from October through March in open Gulf waters, with adults migrating back to inshore waters
37 after spawning. Larvae are passively transported by water currents from the Gulf waters into
38 estuarine waters during October through April. Larval forms feed on pelagic zooplankton. First-
39 year juveniles inhabit shallow estuarine areas in low salinity waters of 5 to 10 ppt. Larger
40 juveniles migrate to deeper, more saline bays and nearshore barrier island waters from May
41 through July. Large schools form at this time. Juveniles are filter feeders and exhibit
42 omnivorous feeding habits (MDMR, 1998).

43
44 Gulf menhaden were the second most abundant fish collected during the GMEI study and were
45 collected throughout the year in all zones. The Biloxi Bay subarea had an overall CPUE of

1 145.16. Zones 3 and 4 of the Biloxi Bay subarea had CPUEs of 18.66 and 14.46, respectively
2 (Christmas, 1973). Based on the GMEI, gulf menhaden are common throughout the study area,
3 but in lower relative abundances than those are observed in other zones. Trawl surveys
4 conducted by the GCRL have also documented the occurrence of Gulf menhaden in the general
5 vicinity of the study area (Figure 3.17-1) (GCRL, 1987-1997).

6 7 *Bluefish* 8

9 Bluefish occur within the Mississippi Sound and offshore waters. This fish is a marine species
10 that does enter estuarine conditions (Christmas, 1973). Bluefish in the Gulf of Mexico appear to
11 be a different stock from those in the Atlantic. Although not well documented, spawning
12 undoubtedly occurs in the northern Gulf of Mexico. In the Gulf of Mexico, bluefish larvae have
13 been collected off the Texas coast (Barger et al., 1978) and probably do occur through much of
14 the northern Gulf of Mexico. A spring spawning also occurs in the northeastern Gulf of Mexico
15 off Louisiana and Panama City, Florida. The larval habitat of bluefish consists of the water
16 column within the area of spawning (GMFMC and SAFMC, 1985).

17
18 Bluefish were not collected during regular sampling events associated with the GMEI study.
19 However, other sources have reported their occurrence in the Mississippi Sound area (Christmas,
20 1973). Trawl surveys conducted by the GCRL have documented the occurrence of bluefish in
21 the general vicinity of the study area (Figure 3.17-1) (GCRL, 1987-1997).

22 23 *Spotted seatrout* 24

25 Adult spotted seatrout occur throughout the Mississippi Sound and nearshore island waters,
26 where they feed primarily on crustaceans and fish. They appear to be most abundant between
27 salinities of 20 to 35 ppt and prefer shallow areas, especially near grassbeds and oyster reefs. In
28 the winter, adults may move to deeper bay areas or to deeper waters offshore. They migrate in
29 the spring to waters adjacent to the northern shorelines of the barrier islands and to mainland
30 nearshore waters. Spawning occurs from March through October with peaks occurring from
31 May through July near offshore barrier islands and adjacent seagrass beds. Larvae migrate and
32 are transported by currents farther into the estuarine environment from May through October,
33 where they are found among bottom vegetation or shell rubble in shallows. Subjuveniles occur
34 primarily among vegetated flats and seagrass beds, where they feed on copepods and shrimp.
35 Juveniles, during the warmer months, prefer shallow areas and vegetated flats within the sound.
36 They tend to school and move into deeper, warmer waters near channels and island passes during
37 the winter months. Juveniles feed primarily on shrimp and small fish (MDMR, 1998).

38
39 During the GMEI study, spotted seatrout were collected in Zones 2 through 5 in all months
40 except May. The Biloxi Bay subarea had an overall catch per unit effort of 0.15. Zone 3 of the
41 Biloxi Bay subarea had a CPUE of 0.52 with none occurring in Zone 4 (Christmas, 1973). Based
42 on the GMEI, spotted seatrout are uncommon within the waters of the study area. Trawl surveys
43 conducted by the GCRL have also documented the occurrence of spotted seatrout in the general
44 vicinity of the study area (Figure 3.17-1) (GCRL, 1987-1997).

Atlantic croaker

The Atlantic croaker is abundant in the northern Gulf of Mexico. Atlantic croaker prefer mud bottom substrates throughout the Mississippi Sound, nearshore island waters, and offshore waters. Young juveniles consume large amounts of detritus, whereas older juveniles and adults feed on mud worms, shrimp, crabs, bivalves, and small fishes. Young juveniles prefer salinities of 0.5 to 12 ppt; however, older juveniles move to more saline waters. Adults are more tolerant of a wide range of salinities than the other life stages. Spawning occurs near island tidal passes and in offshore continental shelf waters in the fall. Larvae are transported via tidal and wind driven currents into the Mississippi Sound during late fall and winter. Larval and juvenile development occur in the estuary. Fish that are three years and older are concentrated offshore and rarely return to estuarine waters (MDMR, 1998).

During the GMEI study, the Atlantic croaker was exceeded in numbers only by bay anchovy and menhaden. The Biloxi Bay subarea had an overall CPUE of 32.57, with the greatest numbers occurring in Zone 4. Zones 3 and 4 of the Biloxi Bay subarea had CPUEs of 62.78 and 106.30, respectively (Christmas, 1973). Based on the GMEI, Atlantic croaker are common throughout the study area with relative abundances higher than those observed in the other subareas. Trawl surveys conducted by the GCRL have also documented the occurrence of Atlantic croaker in the general vicinity of the study area (Figure 3.17-1) (GCRL, 1987-1997).

Striped Mullet

The striped mullet is abundant throughout the Mississippi Sound. Mullet are distributed worldwide and occur within a wide range of conditions ranging from fresh to hypersaline waters. Striped mullet feed primarily on plankton, epiphytic algae, and detritus. Juveniles prefer salinities of 0 to 10 ppt, and adults occur in salinities ranging from 0 to 75 ppt. Spawning occurs in offshore waters from October through May. Larvae are transported by currents into Mississippi Sound during the late fall and winter (MDMR, 1998).

Striped mullet comprised the ninth most abundant species collected during the GMEI study; however, the sampling methods were considered inadequate for accurate sampling of the species. The actual relative abundance is probably much higher than ninth. The Biloxi Bay subarea had an overall CPUE of 8.89. No striped mullet were collected in Zones 3 and 4 of the Biloxi Bay subarea (Christmas, 1973). Based on the GMEI, striped mullet are uncommon throughout the study area. However, trawl surveys conducted by the GCRL have documented the occurrence of striped mullet in the general vicinity of the study area (Figure 3.17-1) (GCRL, 1987-1997).

Southern Flounder

Adult flounder feed primarily on shrimp and small fish near the bottom and prefer mud and mud/sand bottoms. Peak spawning occurs from November through January in offshore waters of the Gulf of Mexico. Larvae and juveniles are transported into estuarine waters during the winter and spring. Juveniles remain in estuarine waters and prefer vegetated waters with salinities of 15 to 20 ppt. Young juveniles are planktonic feeders, whereas older juveniles feed primarily on

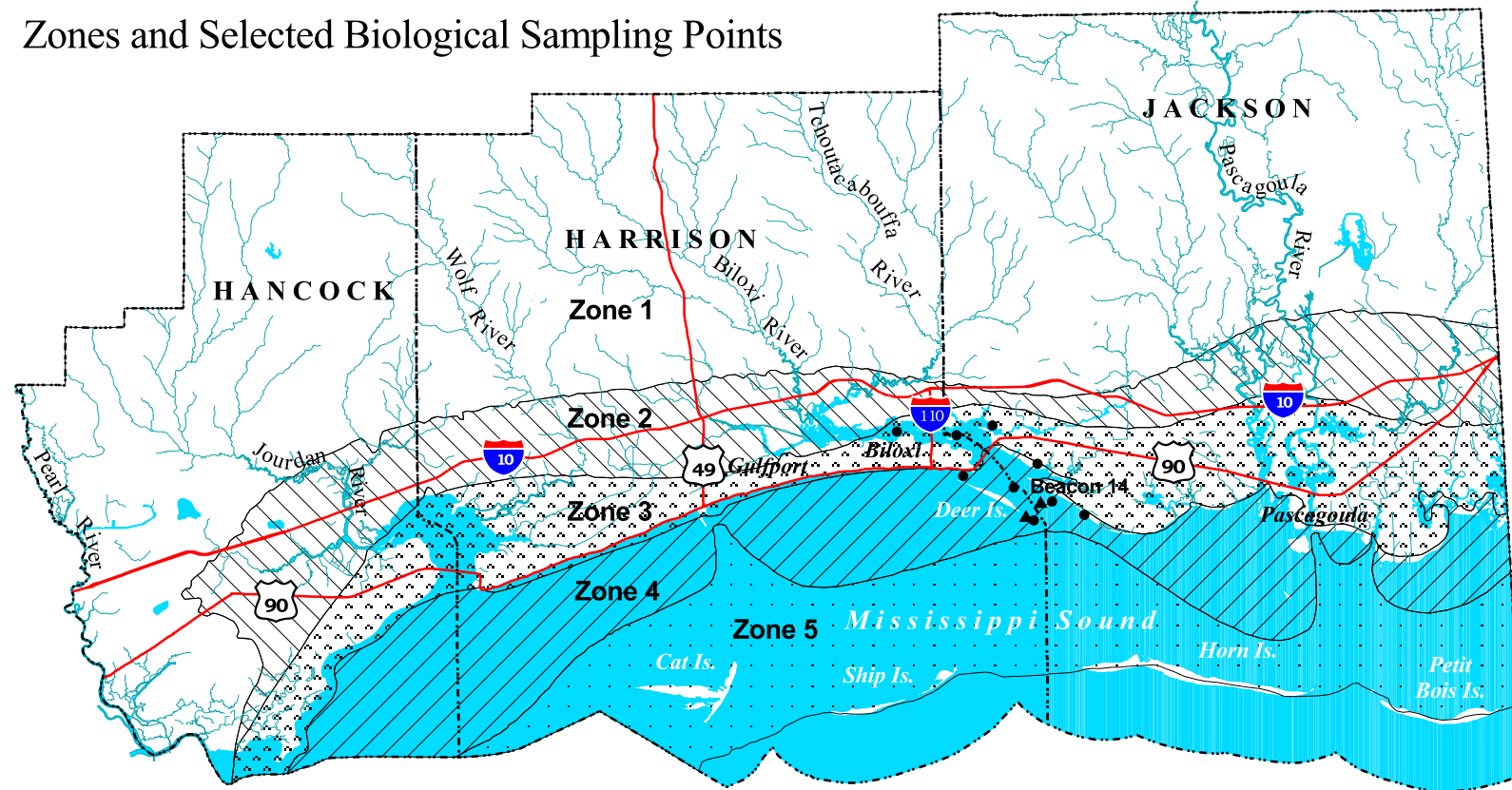
1 crustaceans and small fish. Adults are most common in estuarine waters during the warmer
2 months and are found within salinities ranging from zero to 30 ppt (MDMR, 1998).

3
4 In the GMEI study, the Biloxi Bay subarea had an overall CPUE of 0.21. Zones 3 and 4 of the
5 Biloxi Bay subarea had CPUEs of 0.48 and 0.15, respectively (Christmas, 1973). Based on the
6 GMEI, southern flounder are uncommon in the study area. Trawl surveys conducted by the
7 GCRL have also documented the occurrence of southern flounder in the general vicinity of the
8 study area (Figure 3.17-1) (GCRL, 1987-1997).

9
10 Additional Species of Concern

11
12 Additional species of concern identified by the USFWS within the sound are two anadromous
13 (migrating up river from the sea to breed in fresh waters) species, striped bass (*Morone saxatilis*)
14 and the federally threatened gulf sturgeon (*Acipenser oxyrinchus desotoi*), as well as the
15 catadromous (migrating down river to breed in marine waters) American eel (*Anguilla rostrata*)
16 (letter from B. Garland, Acting Field Supervisor, USFWS, Daphne, AL to Col. J. Norwood,
17 District Engineer, USACE, Mobile, AL, October 30, 1998). Trawl surveys conducted by the
18 GCRL have documented the occurrence of all three species in the general vicinity of the study
19 area (GCRL, 1987-1997).

Destination Broadwater EIS Zones and Selected Biological Sampling Points



Legend:

- Biloxi Bay Subarea Sampling Stations of GMEI
- ▲ GCRL Trawl Stations
- Perennial Streams
- Major Roads
- County Boundaries
- Major Water Bodies

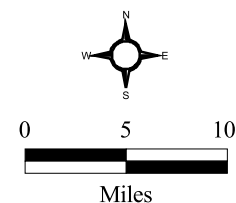


Figure 3.17-1: Selected biological sampling points of the Gulf of Mexico Estuarine Inventory (GMEI) (Christmas, 1973) and Gulf Coast Research Laboratory (GCRL, 1987-1997). Zones from GMEI indicate approximate bottom salinity distribution similarities.